Update Japanese catch and length-frequency data of Pacific blue marlin (*Makaira nigricans*) during 1971-2019

Hirotaka Ijima[1]

[1]Highly Migratory Resources Division, Fisheries Stock Assessment Center, Fisheries Resources Institute (FRI), Japan Fisheries Research and Education Agency. 2-12-4 Fukuura, Kanazawa-ku, Yokohama, Kanagawa, 236-8648, JAPAN

Email: ijima@affrc.go.jp

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Abstract

According to the same fishery definitions as the 2014 stock assessment of Pacific blue marlin, this study updated the catch and length-frequency data. The catch data were compiled in essentially the same methodology as in the previous working paper. However, for coastal longline (F3_JPNCLL) since 1994, I propose to use quarterly data rather than the annual data because the quarterly catch is available. The size data were also compiled in the same way as in the previous study. Both catch and size data were updated consistently with little difference from the last stock assessment and the 2019 catch data is very preliminary.

Introduction

The ISC billfish working group (BILLWG) conducted a stock assessment of the Pacific blue marlin in 2016 (ISC 2016). This stock assessment used the integrated stock assessment model as the Stock Synthesis 3 (SS3). Japanese catch and length-frequency data compiled on an annual and quarterly basis inputted to the SS3. In 2021, the BILLWG plans to conduct a stock assessment of the Pacific blue marlin. This paper updated the Japanese catch and size data using the same methodology as the previous stock assessment.

Material and methods

This study follows the methodology of the previous study (Ijima and Shiozaki 2016). The fleet definition was the same as the last stock assessment, and the catch and length-frequency data aggregated for each of the six fleets (F1_JPNEarlyLL, F2_JPNLateLL, F3_JPNCLL, F4_JPNDRIFT, F5_JPNBait, and F6_JPNOth) by year and quarter (ISC 2016).

Catch data

- F1_JPNEarlyLL and F2_JPNLateLL

The offshore and distant water longline vessel has been submitting the logbook data that is numbers of catch from 1952, and catch number and weight data from 1971. The offshore and distant water longline was divided into two-time series (F1_JPNEarlyLL and F2_JPNLateLL) because the logbook format changed in 1994. F1_JPNEarlyLL and F2_JPNLateLL data aggregated by the logbook data by year and quarter. The catch data of the training vessels were included in offshore and distant water longline. However, these vessels have reported only the number of the catch of blue marlin from 1973-1993. The training vessel catchweight is multiplied by the

catch number and the annual-quarterly average weight of commercial vessels for 1973-1993.

- F3_JPNCLL

The catch data of F3_JPNCLL were generated from the yearbook and logbook data. The logbook data is available for the 1994-2019 period. Therefore, the logbook data were compiled by year and quarter for this period. In the 2016 stock assessment, the BILLWG used quarterly catches as a quarter of the annual catch in the late period (1994-2014). However, this paper proposes to use more accurate quarterly data that was aggregated by logbook data.

The yearbook was used for 1971-1993 because there is no information on the logbook data in this period. The yearbook includes a black marlin catch. Thus, the average catch ratio of blue and black marlin for 1994-1997 was calculated and multiplied by the yearbook to exclude black marlin catches included in the yearbook. The estimated annual blue marlin catch was quartered to use the seasonal SS3 model.

- F4_JPNDRIFT, F5_JPNBait, and F6_JPNOth

The yearbook was used to estimate driftnet fishery's catch data, bait fishing, and other fisheries. There is more detailed logbook data of the driftnet fishery until 1993. However, because of the unclear reporting rate, it will not be used in this study. As mentioned above, the yearbooks recorded without separating blue and black marlin. Therefore, following the previous study (Kimoto and Yokawa 2013), I multiplied the ratio of blue marlin (0.983834309), which was compiled from the Research of Japanese Bluefin tuna (RJB) records, and then dividing it into quarters for each year. RJB is the port sampling research the same as yearbook statistics. The yearbook in 2019 was not available. Thus this study carried over the 2018 catch for these fleets.

Length-frequency data

The length-frequency and weight composition data are available for the size information caught by Japanese fishery. The length-frequency data are available for Offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL), and weight data are available for Driftnet fishery (F4_JPNDRIFT). The unit of the length frequency data is eye-fork length. According to the previous methodology, both length and weight data were summarized (Kimoto and Yokawa 2013). These frequency data aggregated every 5cm or 5kg bin on an annual/quarterly basis.

Results and Discussion

The total catch of the blue marlin in Japan increased slowly until 1985 and then decreased until 1990 (Figure 1). The total catches increased again in the middle of the 1990s, but it showed a sharp decline in 1996 (Figure 1). After 1996, the catch of blue marlin continued to decline slowly (Figure 1). The most common Japanese fishery for blue marlin was the offshore and distant water longline, but in recent years, the proportion has declined to about half of the total catch (Figure 1). The catch data used in the previous stock assessment and the result of this study showed a perfect match, except for F3_JPNCLL and F5_JPNBait (Figure 2). The catch of F3_JPNCLL reflects the updated logbook, while F5_JPNBait's catch in 2014 was preliminary and has been updated since 2016. It is noted that in the 2016 stock assessment, the 2014 F4_JPNDRIFT, F5_JPNBait, and F6_JPNOth catches were carried over from 2013. The spatiotemporal catches of the Offshore and Distant water longliners have been reduced with decreased effort (Figure 3). This trend is consistent with the decline in catches of offshore and distant water longline fisheries in 1996 (Figure 1).

The offshore and distant water longline's length-frequency data averaged about 160cm that is immature fish for both time series (Figure 4). The updated distribution of the F2_JPNLateLL was slightly skewed towards larger fish (Figure 4). It is thought due to the addition of four years of data. The SS3 model of Pacific blue marlin assumes a different growth curve by gender (ISC 2016). The length-frequency data from the training vessels were reported by gender that showed larger females, similar to the growth curve (Figure 5). However, the sex ratio was heavily biased towards males, which may be due to the difficulty in discriminating between genders in small individuals. Therefore, it is not easy to use gender-specific size data at this time. The length-frequency data for the Offshore and Distant water longline by quarterly showed a trend for larger individuals to be caught in the EPO and higher latitudes (Figure 6). It is difficult to explain why the blue marlin's length varies from area to area now, but it may be necessary to consider the "area as fleet approach" in the future stock assessment. The annual variation in size-frequency was generally constant for all seasons (Figure 7). However, the modes were unclear in some periods, and it may be necessary to improve the fit to the SS3 model by using time blocks.

The weight frequency data of driftnet fishery is the same as the previous study result because these data sets did not update (Figure 8, Ijima and Shiozaki

2016). The average weight was 117.8 kg, which is larger than the Offshore and Distant water longline in terms of body length. The data were collected intermittently between 1977 and 1998 and, therefore, this study did not subject to the same data verification as the Offshore and Distant water longline.

References

ISC 2016. Stock Assessment Update for Blue Marlin (*Makaira nigricans*) in the Pacific Ocean through 2014. ISC16 Plenary Report

Ijima, H. and Shiozaki, K. 2016. Japanese catch statistics of the Pacific Blue Marlin (*Makaira nigricans*): Update for a stock assessment. ISC/16/BILLWG/1/02.

Kimoto, A. and Yokawa, K. 2013. Input Data of Blue Marlin Caught by Japanese Fisheries for the Stock Assessment in the Pacific Ocean. ISC/13/BILLWG/1/06.

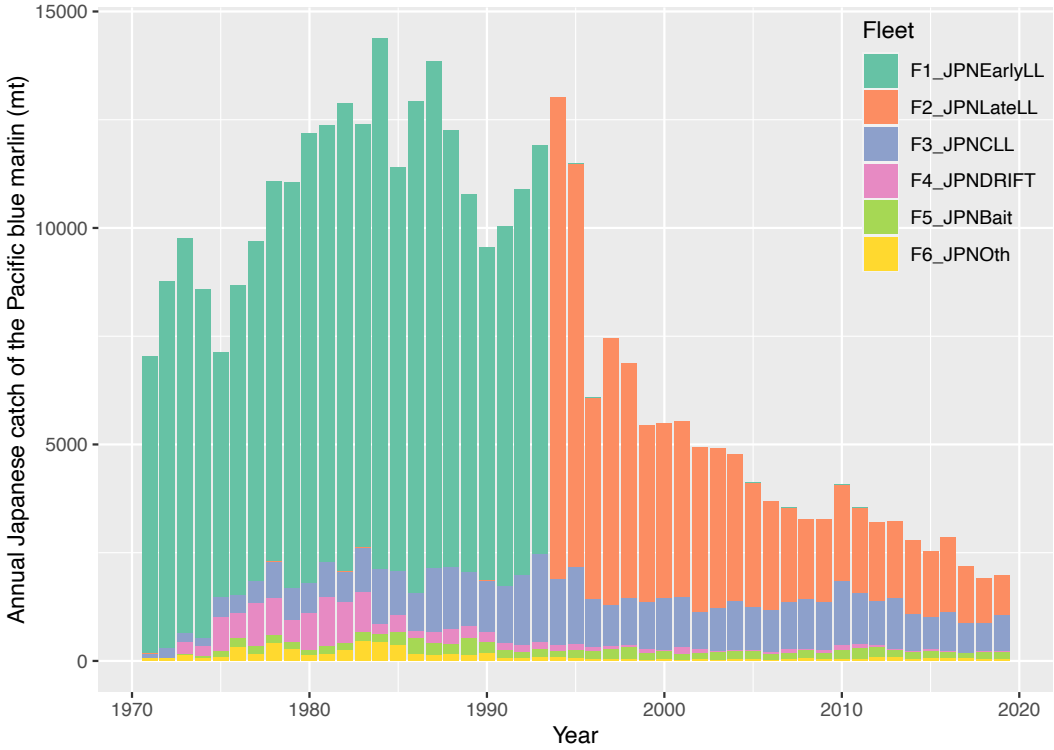

Figure 1. Japanese catch of Pacific blue marlin aggregated by fishery definition of the previous stock assessment.

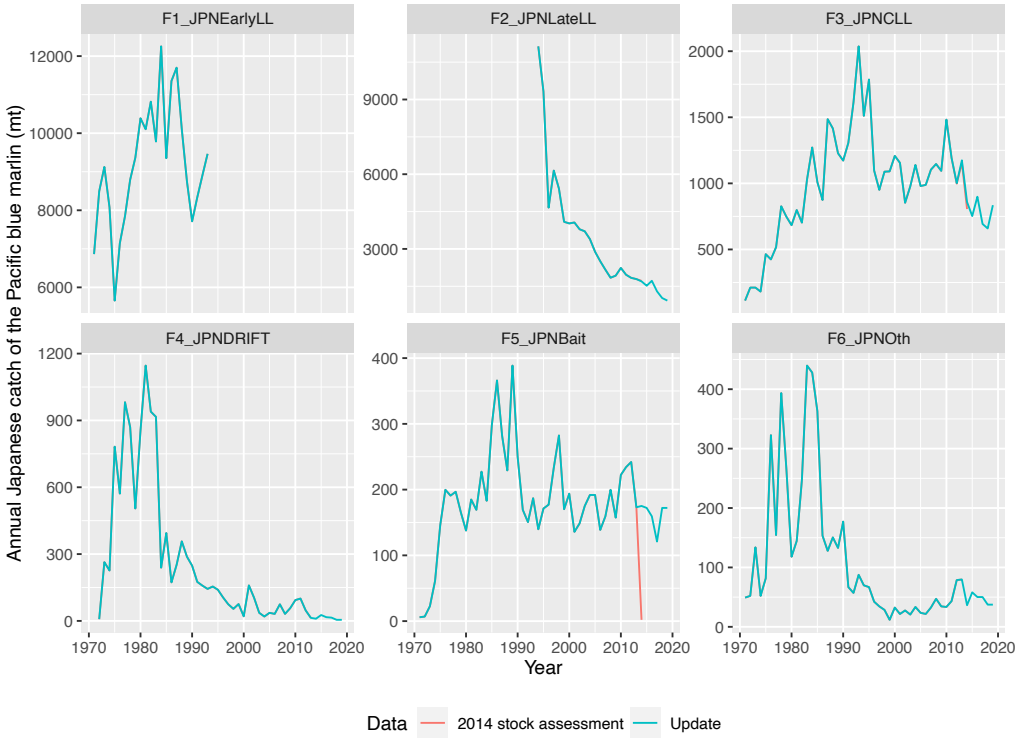

Figure 2. A comparison of the catch data used in the previous stock assessment with the data compiled this time.

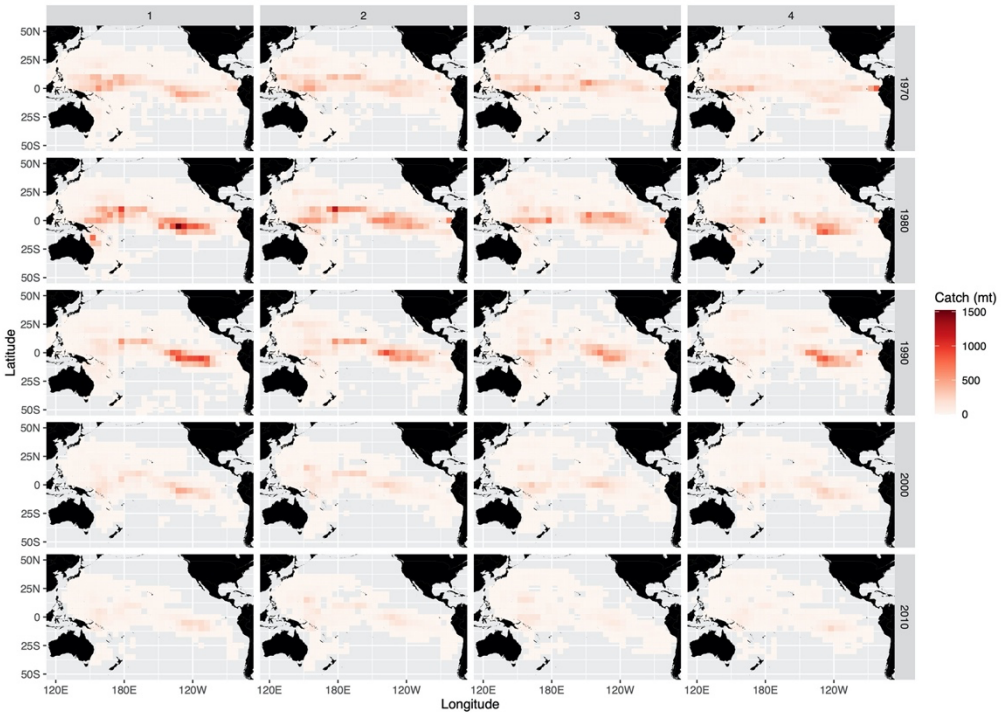

Figure 3. Time-spatial change of Pacific blue marlin catch by Japanese offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL).

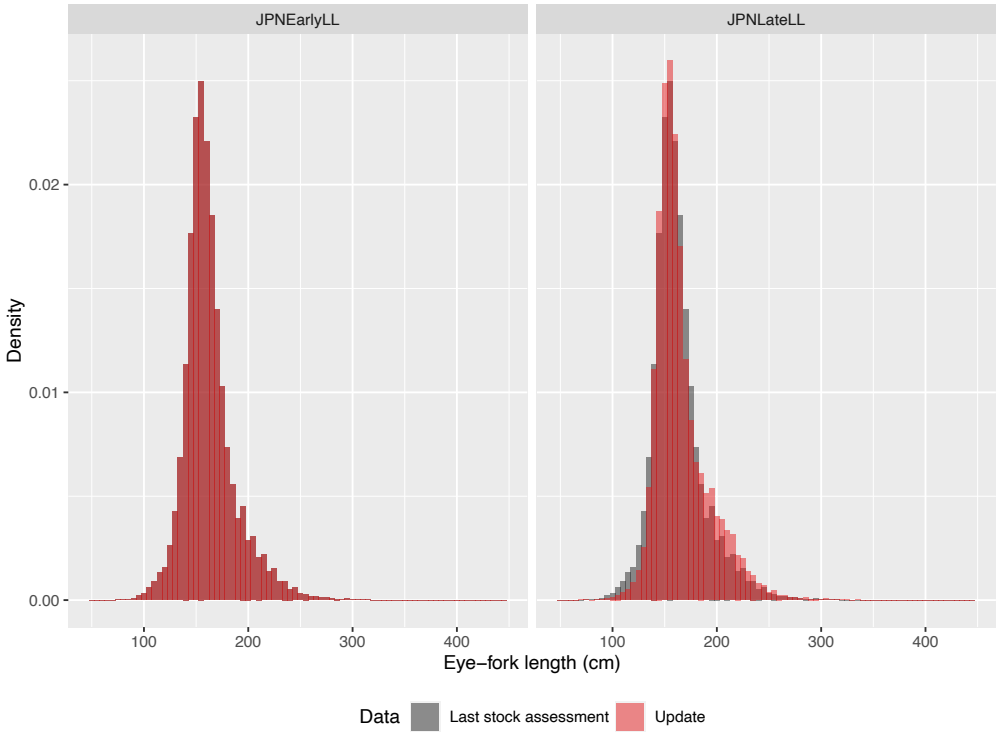

Figure 4. The length frequency data of Pacific blue marlin caught by Japanese offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL).

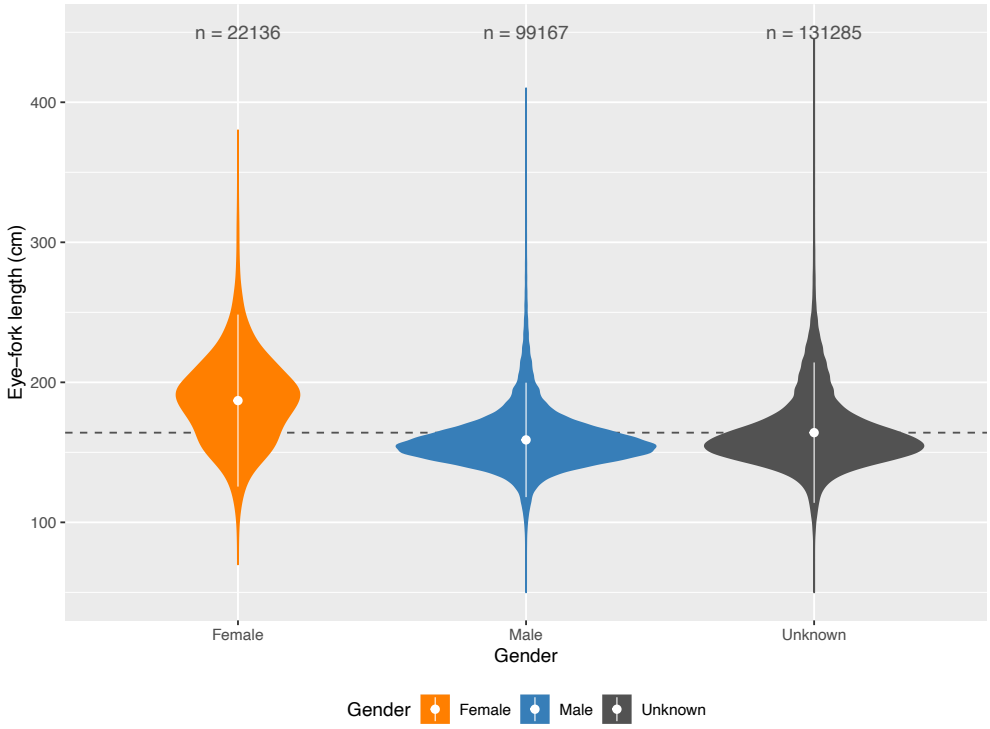

Figure 5. The difference in length frequency of Pacific blue marlin by gender caught by Japanese offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL). Dashed line denotes mean eye-fork length given by all samples.

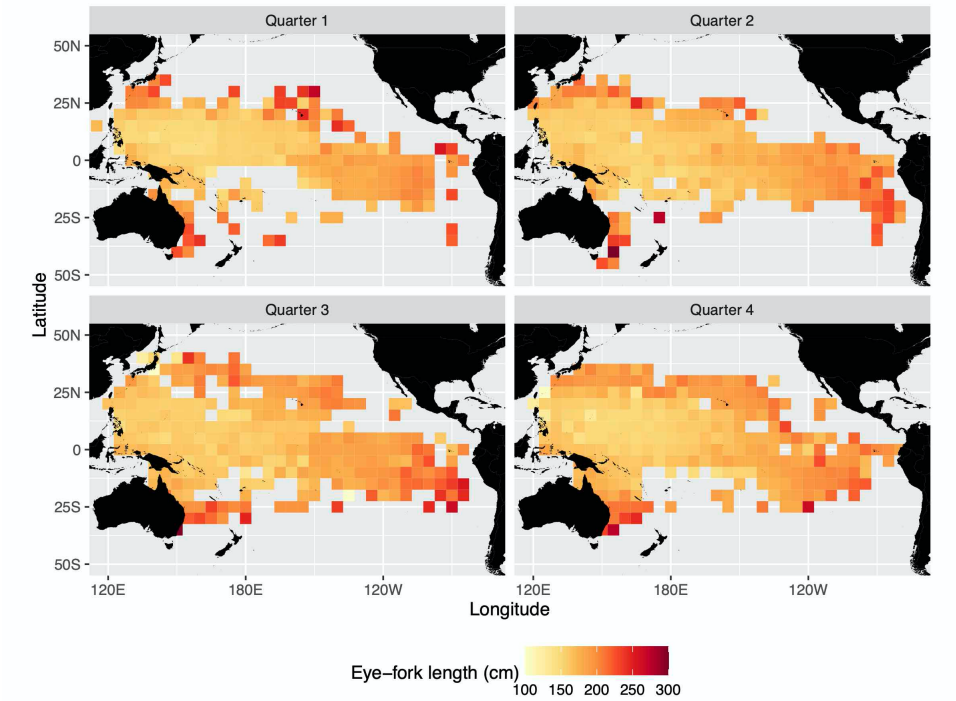

Figure 6. Seasonal-spatial difference of the length data caught by Japanese offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL).

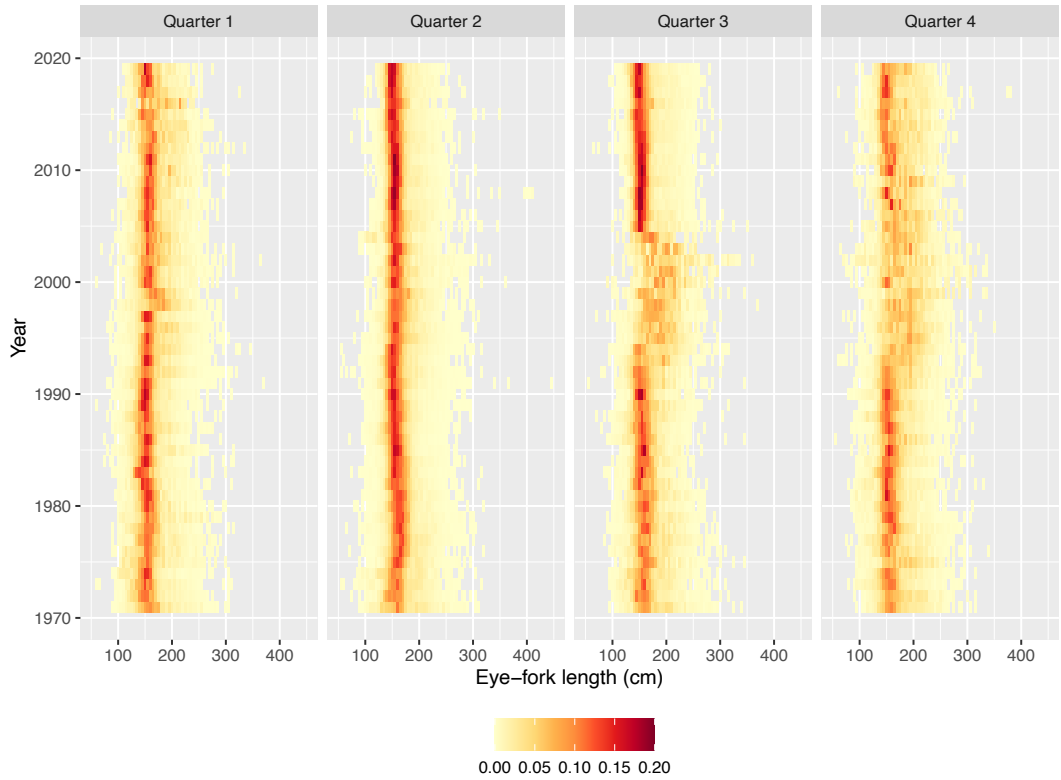

Figure 7. Historical changes in length frequency of Pacific blue marlin caught by Japanese offshore and distant water longline (F1_JPNEarlyLL and F2_JPNLateLL).

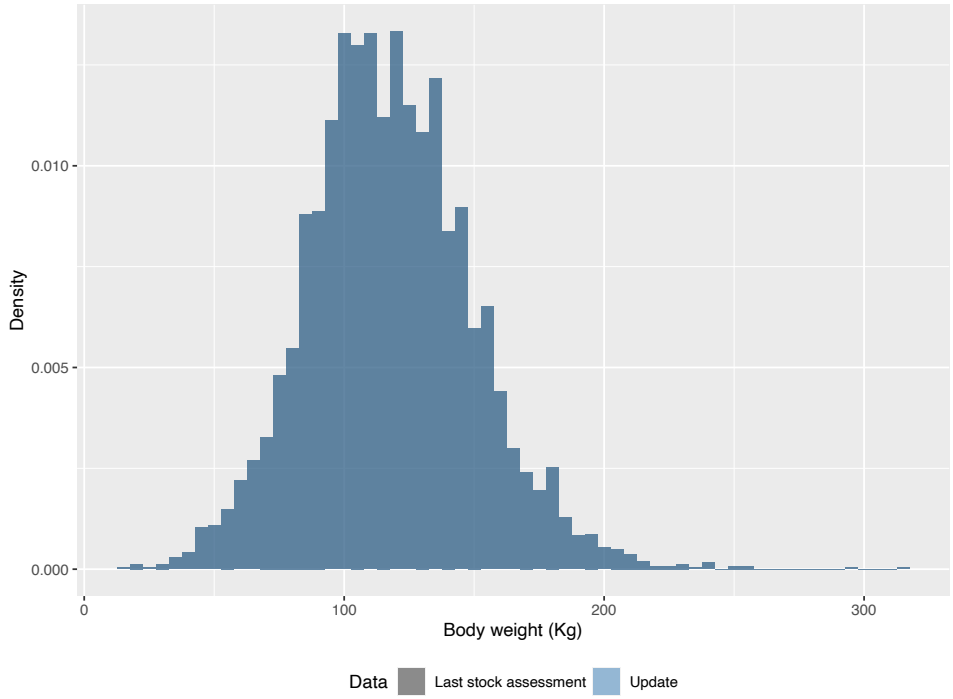

Figure 8. Weight frequency of Pacific blue marlin caught by Japanese driftnet fishery (F4_JPNDRIFT).